Abstract

We propose to begin a systematic exploration of the $p(\vec{e}, e'\vec{n})\pi^+$ and $p(\vec{e}, e'\vec{p})\pi^0$ reactions using the HARP detector by measuring selected in-plane and out-of-plane response functions for $W = 1.232$ and $W = 1.44$ GeV, corresponding to the peaks of the delta and Roper resonances. The measurements will be performed with $\epsilon = 0.9$ so that HARP can be placed at large enough angles to take advantage of its large converter. At $Q^2 = 0.5$ $(\text{GeV/c})^2$ the large angular acceptance of HARP allows the entire angular distribution for pion electroproduction of the Δ to be sampled. The Roper measurements will be performed at $Q^2 = 0.23$ $(\text{GeV/c})^2$ to complement some of the $p(\vec{e}, e'\vec{p})\pi^0$ measurements planned in proposal 91-11 and will cover an angular range of $\pm 40°$ in the center of mass. With HARP centered on q, angular distributions for R_{TT}, $R_{TT}^{\prime t}$, and R_{LT}^t will be obtained from measurements made with the HARP converter in the vertical plane and angular distributions for R_{LT}, $R_{LT}^{\prime t}$, and $R_{TT}^{\prime t}$ will be obtained using the HARP converter in the horizontal plane. Additional measurements with HARP in the vertical plane but centered on floor angles greater that θ_q will provide slices through the opening-angle cone that can be used to determine other response functions through the azimuthal dependence of the reaction. These measurements also provide valuable internal consistency checks. In the Δ region many of the interference response functions are sensitive to the quadrupole deformation of the $N \rightarrow \Delta$ transition. In the Roper region, many of the response functions are quite sensitive to possible longitudinal excitation of the Roper resonance.

Requirements

Beam energy	: 2.33 GeV
Beam current	: 100 μA
Beam polarization	: >60%
Duty factor	: $\sim$ 80%
Target	: LH_2, 1.0 g/cm^2
Detectors	: HRS1 and HARP
Beam time	: 984 hours